

Remarks/Arguments

In response to the Office Action mailed May 17, 2007, Applicants respectfully request that the Examiner reconsider the rejections of the remaining claims.

Amendments to the claims: The claims have been amended to remove the limitation of sidewall reaction in the interest of clarity because that the diazonium specie is capable of reaction at both the sidewalls and the carbon nanotube ends. This is supported by the claims as originally filed.

Claim 85 has been amended to clarify the process of derivatizing the carbon nanotube. New claim 136 has been added to further define the nature of the electrochemical reaction of the diazonium specie with the assembly. No new matter has been introduced by amendment or the additional claim. Support for these claims can be found on page 18, lines 3-27.

I. Rejection under 35 U.S.C. § 103(a) rejections of Claims 69-72, 130 and 132

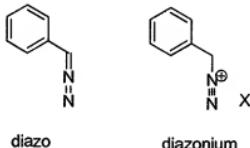
The Examiner has rejected Claims 69-72, 130, and 132 as being unpatentable over Kuekes, *et al.* (U.S. Patent 6,128,214) (hereinafter "Kuekes") in view of Kanayama, *et al.* (U.S. Patent 6,117,617) (hereinafter "Kanayama") in further view of Ruoff (U.S. Patent 5,547,748). Office action at 2-4 (pages 2 and 3). This rejection is respectfully traversed.

Independent claims 69 and 70 disclose processes wherein chemically modified nanotubes are created and used in molecular electronics applications. Chemical derivatization of the carbon nanotubes is accomplished with a diazonium specie.

The Examiner states that Kuekes teaches the covalent attachment of a molecular wire or switch to a fullerene, such as carbon nanotube. This is an inaccurate characterization of the Kuekes patent. Kuekes teaches a two dimensional array of nanometer devices formed by crossing molecular wires, for example, forming an array of junctions. (Col. 3, lines 19-26). Kuekes teaches that as the architecture matures, the nanometer devices that may be employed in

this array may be carbon nanotubes (used as wires) (Col. 3, lines 37-40). Kuekes teaches in Fig. 1 molecules R covering wire 14. Molecule 18, one of molecules R, is identified as a switch molecule. Kuekes, however, does not teach or suggest *covalently* attaching molecule 18 to wire 14. Kuekes teaches that molecules R are part of layer 16 (Col. 5, line 58). Kuekes teaches, in the "Example" section, preparing the molecular species shown in Figs 8A-8C as a Langmuir-Blodgett layer and transferring the layer as a Langmuir-Blodgett single molecular monolayer film 16 (Col. 9, lines 38-41). Molecules in a Langmuir-Blodgett film, as is known in the art, are adsorbed, not covalently bonded. Thus, Kuekes does not teach or suggest covalently attaching a molecule wire to a nanotube. Further, Kuekes does not teach functionalization of carbon nanotubes with a diazonium specie.

The Examiner draws on Kanayama to fill in the missing limitation of derivatization with a diazonium specie. The Examiner has erroneously cited Kanayama at col. 4, lines 66-67. Kanayama does not teach a diazonium specie, but rather a diazo species which is completely different as shown in the Lewis structures below:



Note that the diazo compound is a neutral compound (having nucleophilic character at the benzylic carbon in this example) whereas a diazonium specie is part of a salt where X⁻ represents a counter anion (having electrophilic character at the analogous benzylic carbon). Thus, the reactivity of these two functional groups is completely different.

Finally, the Examiner draws on Ruoff to state that while Kanayama does not explicitly teach reaction at carbon nanotube sidewalls, there is the teaching of Ruoff concerning reaction at curved surfaces subject to strain energy. This assertion is moot due to Applicant's amendments to remove the sidewall limitation. However, in the interests of completeness, Applicant

addresses The Examiner's assertion. The Examiner states without citation that "the sidewall [sic] of carbon nanotubes are bent into a strained configuration on the order of the 2-3 ring diameters...". With all due respect, Ruoff teaches nothing about strain energy at carbon nanotube sidewalls. The Examiner has taken out of context the text at col. 8, lines 29-38 that describes strain in nanopolyhedra, in particular, the strain at pentahedrons (five membered ring entities). Applicant points out that there are no such pentahedron structures along carbon nanotube sidewalls. This point is moot anyway in light of no teaching of reaction with a diazonium specie.

Regarding rejections under 35 U.S.C. § 103(a), to establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on Applicants's disclosure. *See M.P.E.P. § 706.02(j); see also In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

Applicant believes the Examiner has failed to present a *prima facie* case of obviousness. The teachings of Kueckes, Kanayama, and Ruoff, alone or in combination fail to teach or suggest the limitations of independent claims 69 and 70, in particular reaction of a carbon nanotube with a diazonium specie. Claims 71, 72, 130, and 132 all depend either directly or indirectly from claims 69 or 70 and are, therefore, patentable for at least the same reasons. Applicants respectfully request withdrawal of these rejections.

II. Rejection under 35 U.S.C. § 103(a) rejections of Claims 73 and 131

The Examiner has rejected Claims 73 and 131 as being unpatentable over Kueckes, *et al.* (U.S. Patent 6,128,214) in view of Kanayama, et al. (U.S. Patent 6,117,617) in view of Ruoff

(U.S. Patent 5,547,748), in further view of Chen (Science, 1999, 248: pp1550-1552). Office action at 5 (pages 3 and 4). This rejection is respectfully traversed.

Claim 73 and 131 depend either directly or indirectly from independent claim 69. Claim 69 is patentable over Kuekes, Kanayama, and Ruoff as explained above. Chen does not contribute anything further relevant to the patentability of claim 69. Therefore, claims 73 and 131, which depend from claim 69 are patentable over this combination for at least the same reasons. Withdrawal of this rejection is respectfully requested.

III. Rejection under 35 U.S.C. § 103(a) rejections of Claims 85-87

The Examiner has rejected Claims 85-87 as being unpatentable over Kuekes, *et al.* (U.S. Patent 6,128,214) in view of Kanayama, *et al.* (U.S. Patent 6,117,617) in view of Rueckes (Science, 2000, 289, pp 94-97), in further view of Ruoff (U.S. Patent 5,547,748). Office action at 6 (pages 4 and 5). To the extent that this applies to the claims as currently amended this rejection is respectfully traversed.

Independent claims 85 describes a method for derivatizing carbon nanotubes, which involve the electrochemical reaction of an assembly of carbon nanotubes with a diazonium specie so as to derivatize the nanotubes.

Kuekes teaches a two dimensional array of nanometer devices formed by crossing molecular wires, for example, forming an array of junctions. (Col. 3, lines 19-26). Kuekes teaches that as the architecture matures, the nanometer devices that may be employed in this array may be carbon nanotubes (used as wires) (Col. 3, lines 37-40). Kuekes teaches in Fig. 1 molecules R covering wire 14. However, there is no teaching in the Kuekes disclosure to suggest how carbon nanotubes may be derivatized with molecules R. More to the point, there is no teaching or suggestion of the use of diazonium chemistry to derivatize carbon nanotubes. Further, the Examiner has erred as above in identifying the chemistry used by Kanayama. That is, Kanayama teaches diazo chemistry, not diazonium chemistry, for the derivatization of

fullerenes. The same holds for the inappropriate use of Ruoff as cited above.

Rueckes adds no teaching or suggestion for the electrochemical reaction of carbon nanotubes with a diazonium specie.

Applicant believes the Examiner has failed to present a *prima facie* case of obviousness. The teachings of Kueckes, Kanayama, Rueckes, and Ruoff, alone or in combination fail to teach or suggest the limitations of independent claim 85, in particular reaction of a carbon nanotubes with a diazonium specie. Claims 86 depends from claim 85 and is, therefore, patentable for at least the same reasons. Applicants respectfully request withdrawal of these rejections. Claim 87 has been canceled by amendment and its rejection is therefore moot.

Conclusion

No new matter has been added. Applicants respectfully submits that the Claims as they now stand are patentably distinct over the art cited during the prosecution thereof.

With the addition of no new claims, no additional filing fees are due. If additional fees are due and are not included, the Director is hereby authorized to charge any fees or credit any overpayment to Deposit Account Number 23-2426 of WINSTEAD PC

If the Examiner has any questions or comments concerning this paper or the present application in general, the Examiner is invited to call the undersigned at 713-650-2632.

Respectfully submitted,

WINSTEAD PC

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